

## **The Question of Education in Technological Society**

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Among the great challenges facing the prospect of citizenship today, two can be singled out as particularly serious: the challenge of difference; and the challenge of technology. To say that these are challenges for citizenship is also to say that they are challenges for education, at least to the extent that it is still sensible to believe that education bears some responsibility for the cultivation of citizenship. The challenge of difference—the challenge of establishing a viable conception and practice of citizenship in the context of radical cultural pluralism and heterogeneity—is one that has received considerable critical attention in recent years (Isin 2002; Kymlicka 2002). The challenge of technology has received less attention, perhaps because the modern inclination is to view technology as either neutral or unambiguously beneficial with regard to citizenship: as I will suggest below, our public culture predisposes us towards recognizing technology primarily as an opportunity, and not especially as a challenge. Against this view, I will elaborate a fairly simple set of claims: that technology presents a challenge for citizenship; that this challenge has implications for education; and that our collective response to this challenge in the sphere of formal education has been less than adequate.

### **Citizenship**

There are several conceptions of citizenship that could serve as a normative ideal in relation to technology. One could adopt a classical liberal conception, in which citizenship names the individual possession of rights and establishes the boundaries of membership in a political community. Or, one could opt for a model of social citizenship, which emphasizes the distribution of social and

material resources that allow people to act on otherwise abstract liberties. Finally, there is the conception of citizenship as a regulatory or disciplinary category central to the operation of social reproduction and cultural transmission. Each of these can raise productive questions about the politics of technology. That being said, to get at the heart of the problem of citizenship in technological societies, I recommend a fourth, more demanding model of citizenship—the republican model.

The republican conception of citizenship is rooted in ancient political philosophy and taken up, to varying degrees, in modern theories of strong, deliberative, participatory democracy. As Ronald Beiner (1992: 104) defines it, republican citizenship consists in:

active participation in a dialogue that weighs the substantive merit of competing conceptions of the good and that aims at transforming social arrangements in the direction of what is judged, in this active public dialogue, as the best possible (individual and collective) good.

Citizenship is here defined in terms of an active practice of public judgment about collective ends and the means to achieve them, through engagement in the public sphere amongst public-spirited fellows, animated by common concern for what is good and just.<sup>1</sup> Whereas liberal conceptions of citizenship define citizenship in terms of *membership*, and social citizenship is defined in terms of the *distribution* of material resources, republican citizenship is defined in terms of a particular, distinctive, *practice*. The question raised by liberal conceptions of citizenship is who gets *in*; the question raised by social citizenship is who gets *what*; the question raised by republican citizenship is what people *do*. It is a theory of citizenship that is concerned not just with “a more *extensive* civic membership,” or even a more *equitable* distribution of civic resources, but also, or perhaps rather, with “a more *intensive* civic experience” (Beiner 1992: 114; Petit 1997).

Republican citizenship is, of course, fraught with a theoretical legacy, and a practical history, of elitism and exclusion, a history that raises serious doubts about the possibility of a citizenship that is both republican and democratic at the same time. Any thoroughgoing defense of the republican model of citizenship would have to reckon with this history and provide a persuasive account of how republican citizenship could be anything other than aristocratic, gendered and racist (Maynor 2003; Petit 1997). My purpose here is rather just to shine a light on the challenge that technology poses for citizenship, a challenge that becomes most visible in the demanding practical light of republican citizenship, despite its liabilities. Furthermore, it is something like republican citizenship—a citizenship defined by participation in public judgment about

ends and means—that is most greatly challenged by the material facts of technology, and by the affordances of contemporary technological societies.

### **Technology**

What is the challenge that technology poses for citizenship? The answer is far from self-evident, not least because the cultural dispensation of modern technological society inclines toward a view that technology sets before citizenship not a challenge but rather an opportunity. The instrumentalist approach to technology, in which technology is understood to be nothing but an indifferent set of instruments whose proliferation and perfection pave the way for the progress of freedom and prosperity, does not conceive of technology as a problem at all. In this view, which still prevails in our public culture, the presumed material benefits of technological advance are understood as a condition and confirmation of democracy, citizenship's greatest security, not its greatest problem. Nowhere is the tenacity of this conviction more evident than in relation to new information and communication technologies which, like basically every technology of mass communication that preceded them, have been equated in the popular mind with either the salvation or extension of democratic citizenship (Mosco 2004).

Fortunately, the 20<sup>th</sup> century has provided for us not only a formidable set of technological instruments, but also a formidable body of critical theory that reveals this instrumentalist view to be ideological. The list of thinkers who, despite their variety of approaches and significant differences, have put paid to the notion that technology and democracy are necessary or uncomplicated allies, is a long one, stretching from the likes of Heidegger, Horkheimer, Marcuse, Habermas, Ellul and Mumford at one end to Winner, Feenberg, Haraway, Latour and Borgmann at the other. If there is one thing that critical theorists of technology seem to agree upon despite their many differences, it is that the relationship between modern technology (whether in its essential characteristics, or as it has been socially constructed in the context of liberal capitalism) and citizenship is ambiguous, at best (Melzer, Weinberger, & Zinman 1993).

Assuming there are theoretically justifiable grounds for asking after the challenge technology poses for citizenship, it remains necessary to disaggregate the specific ways in which technology bears on citizenship, of which I believe there are three: as potential *means*; as a potential *object*; and as a *setting*.

As potential *means* of citizenship, technological instruments can be used as tools of citizenship practice, a possibility that is most obvious with regard to mass media and communication technologies, and which has been raised to

high relief by the Internet. Citizenship as engagement in public judgment about ends and means is necessarily a communicative practice, and there is no reason to assume that technological mediation of communication, even on a mass scale, cannot be, or has not sometimes been, configured to support rather than to undermine this practice. Television has become an instrument by which people are “demoralized in the shortest possible time on the largest possible scale at the cheapest possible price,” as Kierkegaard (1967, vol.2, no.489) once said of the daily press, but it could just as easily be configured to elevate and inform public judgment, as it sometimes does, in some contexts. And the Internet, already a medium of everything *but* citizenship—entertainment, personal correspondence, labor, consumption, and surveillance—is only *predominantly*, and not exclusively, so. One would have to harbor a quite irrational animus against technology to deny the significant citizenship activity presently mediated by the Internet, or to dismiss the likelihood of its persistence, however marginal it might be in the present scheme of things, and however strongly the political economy of contemporary capitalism militates against it. In short, technology, especially communication technology, is almost always a potential means of citizenship, and it is well not to lose sight of this, perhaps *especially* because this potential has been so seldom, and only ever marginally, realized (MCAughey & Ayers 2003; Wilhelm 2000).

Technology (and here we move well beyond the confines of communication technology) is also potentially an *object* of citizenship, which is to say that technology comprises not just a medium through which we might engage in public judgment about common ends and the means to achieve them, but also that technological artifacts and systems *constitute* ends and means in relation to which we might reasonably expect to exercise public judgment. In a social world in which technology often seems to appear as if by magic, and to be non-negotiable in its outcomes, it perhaps seems fantastic to suggest that technology is properly an object of citizenship, but this is precisely what the very best democratic critiques of technology have taught us. Technology must be understood as an object of citizenship because, as Andrew Feenberg (1999) has argued, it is “legislative”; because “artefacts,” as Langdon Winner (1986) has taught us, “have politics”; because “code,” as Lawrence Lessig (1999) has written, “is law.” Technology is properly an object of citizenship because it is intimately bound up in the establishment and enforcement of prohibitions and permissions, the distribution of power and resources, and the structure of human practices and relationships. So many of our ends (whether genuinely common or not) and the means for achieving them are realized technologically that denying technology as an object of citizenship prejudicially depoliticizes a massive portion of contemporary social existence (Winner 1995).

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Technology should be considered an object of citizenship not only because it *has* political outcomes but also because it *is* a political outcome. The sociology of technology has taught us that technological artifacts and systems are not *just* objects; they do not emerge automatically from the rational, disinterested, objective progress of science. Like legislation, technologies are the product of complex institutional arrangements, and equally complex sets of assumptions, priorities, relationships and contests (Bijker, Hughes & Pinch 1992; Bijker & Law 1992; MacKenzie & Wajcman 1999). Were this not the case—were there no contingency in technological outcomes—to speak of technology as a potential object of citizenship would be to speak in vain. Technologies are not *just* objects, but technology can be made *an object of citizenship* precisely because it remains open to political intervention.

It is possible to imagine citizenship exercised upon the object of technology in a number of ways. We could imagine, for example, citizens exercising political judgment in the selection, design and development of technological artifacts and systems. We could also imagine a role for citizens in the regulation and governance of technologies that are already in place. Of course, the fact that we have to *imagine* such roles is instructive: in their current configuration, most societies in which technology figures centrally exhibit a paucity of meaningful opportunities for citizenship in relation to technology itself. In these societies, political judgment about technology, whether at the point of design or governance, is typically reserved for some combination of scientists, engineers, businessmen and technocrats who, while they are certainly citizens as well, do not necessarily bring the disposition and concerns of a citizen to bear in their professional determinations (Noble 1977). Most people encounter technology as consumers or users, not as citizens. This absence of institutional opportunities for citizenship means that whatever political agency people retain in relation to technology is exceptional and subversive, exercised sporadically through what Feenberg (1999) has called “democratic rationalization” (130) of otherwise undemocratic instruments and systems.

Citizenship is also challenged by technology because technological *societies* do not provide a *setting* that is necessarily hospitable to its practice. A technological society is one that is saturated by complex technological devices and systems, and which experiences perpetual technological dynamism; it is one in which material life, and in particular the economy, is bound up tightly with technological activity; one in which security, prosperity, freedom and progress are identified culturally with technological development; and one in which the instrumental rationality characteristic of technology, in which the question of ends is subsumed under the optimization of means, penetrates otherwise non-technological spheres of interest and activity.<sup>2</sup>

Technological societies truncate the possibilities of citizenship because the question of the good life is fundamentally answered in the very fabric of their material constitution. This is why technology comports so well with liberal conceptions of citizenship. Whereas technology and liberal democracy are characteristically presented as neutral as to possible ends, both, in fact, embody a substantive view of the good life as self-realization and mastery, achieved through individual choice-making unfettered by any restraint other than those for which we freely volunteer. The Canadian philosopher George Grant (1969) has characterized the relationship between technology and liberal democracy in precisely this manner, seeing both, along with capitalism, as expressions of the modern conviction that the human essence is freedom (114). This is not to say that liberalism, capitalism or technology have actually *delivered* on the promise of freedom; it was not so long ago, after all, that the Frankfurt School characterized technology as capitalist domination materialized, and liberalism as its apology (Horkheimer 1990; Horkheimer & Adorno 2002). In any case, the point is that the affinity of technology, capitalism and liberalism derives not from their abstinence on the question of ends, but from their common conviction that a certain kind of freedom is the only possible answer to that question. As Albert Borgmann (1984) writes:

Liberal democracy is enacted as technology. It does not leave the question of the good life open, but answers it along technological lines...when we promote a just society along liberal democratic lines we also advance the technological society and its specific and dubious notion of the good life. (93–94)

Technological society, then, is itself a decisive, if often unspoken, answer to the question about ends, one which obviates, rather than invites, the practice of public judgment that defines citizenship, at least in its more demanding forms. Having reached hegemonic proportions, technological society's promise of the good life leaves little room for political judgment. Indeed, in a technological society that is also a liberal (and capitalist) society, citizenship—as a practice in which ends and means, including technology itself, are subjected to public judgment—can only get in the way of realizing that version of prosperity about which there can be no question.

### **Education**

To review, technology challenges citizenship in three ways: as a potential means; as a potential object; and as a necessary (because practically unavoidable) setting. There is the challenge to optimize technologies (such as, for example, the Internet) as effective means of political participation and judgment; the

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challenge to enforce the political judgment of citizens upon technological design, development and governance; and the challenge to recover ground in technological society for public judgment as to ends, including the end of technology itself.

Whether citizenship will rise or succumb to these challenges depends on a variety of factors, only one of which is education—though education is, arguably, a crucial one. The notion that education is central to the possibility of citizenship is so well-worn that it hardly needs mentioning. This is perhaps especially true in relation to the more demanding, republican conception of citizenship I have emphasized here: liberal citizens are typically born into their rights, or acquire them either through due process as immigrants or struggle as revolutionaries; citizens with the inclination, capacities and habits of participation in political judgment must be cultivated, and education is a primary means of cultivation.<sup>3</sup>

Nevertheless, to speak of education as the cultivation of citizenship is to assume a certain risk. We should not forget the history of the use of education by states and churches in order to “civilize” various troublesome populations. Citizenship education can take, and has taken, several unacceptable forms: “civics” education aimed at legitimation and depoliticization of the status quo; cultural, religious and linguistic unification of diverse populations along national lines, typically with violence to difference and history; transmission of the dominant ideology; and reproduction of, and habituation to, social regimes of discipline and normalization that maintain prevailing distributions of socio-economic power. In my own country of Canada, for example, aboriginal children were forcibly taken from their parents and their homes and incarcerated in residential schools, where they were denied access to their heritage, their language and their culture, and often physically abused, all in the name of making “good citizens” of them (Fournier & Clay 1997). Thus, the terrain is dangerous, but it cannot be avoided. The fact is that formal education exists, and it cultivates us as subjects whether we like it or not (Bourdieu 1977). The only question is what sort of subjectivity it cultivates, or fails to cultivate. If we are to hold out hope for citizenship in technological society, it seems unavoidable that we think through the contribution formal education might make to this outcome, not *despite* the fact that citizenship education has sometimes gone so horribly wrong, but rather *because* it has.

Technology challenges citizenship as a potential means. For that potential to be realized—for example, in relation to communication technologies—a number of structural changes in the political and cultural economy of mass commercial media would have to occur, changes aimed at extricating mass media from the grip of capitalist corporations and redirecting them toward the

service of democratic communication (McChesney 1999). Assuming these structural changes, what would citizens need in order to make the most of this potential, to appropriate these technologies as means of public deliberation and judgment on a significant scale? At a minimum, they would require *facility* with these technologies, the capacity to use them creatively, with relative ease, for political purposes—which is to say in order to inform themselves and others, and to participate in deliberation and dialogue pursuant to public judgment on matters of common concern. Many people already enjoy such facility; too many do not. An educational program aimed at cultivating citizens capable of rising to the challenge of technology as a potential means of citizenship would seek to promote this facility. This is not a particularly demanding expectation in the current context; as I will suggest below, contemporary education systems are *already* oriented significantly in this direction.

Technology also challenges citizenship as a potential object. Meeting this challenge would require a fundamental structural reform of the institutional basis of technology design, implementation and governance. As mentioned above, participation in decision-making regarding technology is more or less reserved for scientists, engineers, corporate executives and technocrats, who tend to equate the public good with some combination of efficiency, productivity and economic growth. Citizens are typically invited to the table primarily as consumers, whose sole choice with regard to technology is whether to buy or not. To make technology properly an object of citizenship, institutional regimes of technological design, implementation and governance would have to be systematically reconfigured to place citizens and their deliberations at their center. Assuming this was accomplished, what would citizens need in order to engage in public deliberation and judgment about technology and technological issues? At a minimum, they would require the disposition and habits of citizenship *in relation to technology*. Beyond this, they would need a certain degree of *literacy* with respect to technology and the issues arising from it, including an awareness of the possibilities of technological reform and restraint. An educational program aimed at cultivating citizens capable of rising to the challenge of technology as an object of citizenship would have to actively incline students to approach technology *as a political issue*, and habituate them to engagement in public deliberation and judgment about technology. It would also seek to equip students with the literacy necessary to do so critically and autonomously, not necessarily as experts, but as citizens able to evaluate the claims that experts make.

It must be kept in mind that literacy can serve hegemonic, as well as critical, purposes. Reading can enroll us in the dominant culture just as easily as it enables us to critique it. In some accounts, technological literacy amounts to

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little more than an uncritical appreciation of “where things come from” and “how things work,” a sort of “know-how” aimed at reproducing technological society rather than provoking critical engagement with it. For example, in 1999, the Committee on Information Technology Literacy of the National Academy wrote that technological literacy demands:

that persons understand information technology broadly enough to be able to apply it productively at work and in their everyday lives, to recognize when information technology would assist or impede the achievement of a goal, and to continually adapt to the changes in and advancement of information technology.

There is little or no room in this conception of literacy for a reading of technology that might call into question its basic assumptions and operation. This is why it is necessary to specify that the sort of literacy citizens need in order to rise to the challenge of technology as an object of citizenship is *critical* technological literacy: the sort that equips citizens to read through the ideology and operation of technology and into its historicity, its situation in the political economy of capitalism, its affordances and its denials. The expectation of critical technological literacy demands more from contemporary education than does mere technological facility—but it is still, I think, well within the horizon of technological society.<sup>4</sup>

It is not clear that the same can be said about the recommended educational response to the third challenge technology poses for citizenship, that in which technological society constitutes the material, epistemological and ontological setting in which the possibility of citizenship is situated. Citizenship, as I have argued, centers on political judgment and public deliberation about ends, and the best means to achieve them. The challenge that technological society poses for citizenship is that, at a fundamental level, it constitutes a decisive answer to the question of ends, the question of the good life. The answer is freedom as self-realization, expressed in and through the proliferation and extension of technology. It is an answer that discourages alternatives, makes the question itself seem redundant and, in so doing, erodes the ground of citizenship. Indeed, the consensus around this end is such that technological societies are able to devote almost all their political energy to squabbles over means. The only conceivable response to this challenge, aside from either nihilist abandon or apolitical passivity, is to recover and restore the ground of citizenship, by sustaining the possibility of thinking—*publicly*, not just privately—about ends other than that of self-realization by means of technology.

What contribution can education make to this effort? To say that citizenship demands the possibility of thinking about a plurality of ends is to say that it requires sustaining the possibility of humanity against the dominant culture of

technology (Borgmann 1984, 1992). There is a clue in this phrasing. It suggests that the best hope for citizenship in technological society lies in an education that cultivates the human capacity for judgment as to ends, an education rooted in the humanities, for it is only in the humanities—in history, in art, in music, in literature, in philosophy, in the study of religion—that the question of ends is regularly raised for consideration (Grant 1969). It is only in the humanities that the question of ends has not been shunted aside by the assumption that it has already been answered. Humanities education is not a denial of the reality of technological society, but rather a recognition of the depth of the challenge such a society poses for citizenship. It is not an escape from technological society; but a practical response to its basic character.

Two qualifications are necessary here. The suggestion is not that we look to the humanities for *instruction*: Hamlet cannot instruct us as to the relative merits of private vengeance and public justice. Immersion in the humanities will not tell us what our ends should be; it will habituate us to a practice in which the question of ends is publicly present, open, and routinely engaged, rather than absent, closed, and systematically evaded. By bringing the question of ends forward into beauty, the humanities *accustom* us to precisely that aspect of citizenship that is missing in technological society.

When the humanities are instrumentalized as means of ideological transmission and “civilization,” they are reduced to mere counterfeit, which brings me to the second qualification. To call for an education in the humanities that develops the habits of engagement with a plurality of possible ends, is necessarily to reject an education that confines itself to reproducing *one* tradition, *one* vocabulary, *one* account of what it is to be human. The only humanities education worth its name is one that affirms rather than denies the plurality of possible ends, one which not only recognizes but celebrates that literature means literatures, history histories, and philosophy philosophies. In this manner, the point of a humanities education is not so much cultural as ethical. It is not about the generalization of a common vocabulary; it is about a generalized habit of engaging with the question of ends, a question that can be asked using many possible vocabularies, including subversive ones.

These, then, are the educational responses I would propose in response to the challenge posed to citizenship by technology as means, object and setting: technological facility, critical technological literacy and the humanities, in all their pluralism. These responses exhibit escalating levels of difficulty. Technological facility beyond that required for proletarian labor and consumption is at least imaginable within the current horizons of education in a “knowledge-based society,” as is technological literacy, perhaps even the critical variant. The prospects for the humanities, at least as a systemic educational

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commitment, are less certain within these horizons. There is only so much we can do. One wonders whether, as a practical matter, an education system committed to technological facility and literacy could *also* be committed to the humanities, or vice versa. The problem of the epistemological fit between these three proposals is even more vexing than the practical one. For wouldn't a commitment to technological facility and technological literacy imply agreement with the answer given by technology to the question of ends? And wouldn't an education centered upon technological facility and literacy amount to precisely that overriding attention to means that is the *problem* humanities education is supposed to correct? Does it make any sense at all to endorse each of these three at the same time?

This is a considerable dilemma. Still, an education geared to only *one* of *either* the technical *or* the ethical priorities I have discussed would leave us only half-equipped to meet the challenges of citizenship in a technological society. Technology is not about to disappear—one might argue that our recent experience with digital networks is but a gentle prelude to the dynamism to come with nano-, bio- and genetic technology. We will be unable to deal with technology as a means and object of citizenship if we are not equipped with technological facility and critical technological literacy. But we will also be unable to recover the very *ground* of citizenship, a ground defined by engagement in public judgment as to ends, without an education that habituates us to asking the question of ends, against the apparent monism of liberal, capitalist, technological society (Grant 1969: 114). For this we need the humanities as well. And so, I would argue, what appears to be a practical and epistemological contradiction might nevertheless be a political necessity.

Attention to this necessity has been less than fulsome. In general, affluent capitalist democracies have been keener to orient their educational systems to the demands of capital accumulation in the context of so-called "information," "knowledge" or "network" society than to the ongoing challenge to citizenship posed by technology (Noble 2002; Robins & Webster 1999; Sears 2003). This orientation has several features:

- ? investment in education as the foundation for a competitive economy based on innovation;
- ? emphasis on the commercialization of research, including support for public-private partnerships and closer integration of universities and the private sector;
- ? vocational orientation to the demands of post-Fordism, including the generation of both highly skilled and highly "flexible" workers;

- ? stress on perpetual training and skills development, euphemized as “lifelong learning”;
- ? support for integration of technological infrastructure in educational settings.

At the level of institutions, priorities have included:

- ? expansion of access to new technologies and network infrastructure;
- ? development of platforms and pedagogies for technologically-enhanced and mediated learning, including distance learning;
- ? use of technology to realize efficiencies/flexibilities in information and education delivery, including administration and instructional labor;
- ? digitization of instructional materials, including library resources;
- ? development of students’ and educators’ technology skills and competencies.

These things are not necessarily bad. In their hegemonic applications under the auspices of contemporary neoliberalism, such measures are politically and pedagogically suspect, and should be resisted in the name of democratic education. However, practices such as distance education or online learning are also open to appropriation for decidedly democratic purposes, and good educators everywhere are working hard to develop and deploy tools and pedagogies conducive to this outcome (Hamilton & Feenberg 2005). Which of these models will prevail is not a foregone conclusion, and prejudicial dismissal of the progressive possibilities of technologically-mediated teaching and learning serves only to guarantee an unhappy result. It is also true that two of the responses advocated above—technological facility and technological literacy—do appear. In most cases, these are specific to digital media, and it is not yet clear whether the literacy models popping up in some jurisdictions are oriented to enrolment in technological society or to critical citizenship. Nevertheless, they do arise, though this should come as no surprise given how comfortably at least certain versions of facility and literacy sit within the horizon of technological society.

It is not that the current agenda is uniformly or necessarily opposed to citizenship, but rather that citizenship *as a special challenge in technological contexts* does not figure highly in the present imagination of the place of education in relation to technology. Where citizenship does appear, it is in the form of active and productive membership in the highly competitive knowledge economy, or as a category of entitlement to equal access to technologically-mediated benefits and services. These are not insignificant things: they are also not all there is to

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citizenship. There is also the matter of public engagement in political judgment, including judgment about technology itself, not just as a means but also as an end. Citizenship of this sort runs counter to the current of contemporary technological society and also, it would seem, to current priorities for an education system designed to serve that society. This is a serious political problem, one that calls for an equally serious political effort on behalf of the priority of citizenship in the educational agenda of technological societies.

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**Notes**

1. The politicization of the good *and* the just distinguishes republicanism from most versions of liberal democracy. In the latter, politics is comprised of the contest, within neutral institutions and procedures, over just outcomes, in light of a background conception of the good that is presumed to be shared. In most liberal models, politicizing the good life is a recipe for unjust outcomes or, worse, perfectionism leading to domination and subordination, especially in contexts where cultural pluralism is an irreducible fact of life. Republicanism, by contrast, assumes that questions of the good life are always in play and ought, therefore, to be part of political deliberation. It is for this reason that republicanism and liberalism are often posited as incompatible (Kymlicka 2002: 294–99).
2. Obviously, this substantivist conception of technological society owes a great deal to the accounts given by: Martin Heidegger (1977), Herbert Marcuse (1964) and Jacques Ellul (1964).
3. Classic statements on education and republican citizenship include Aristotle (1967) and Niccolo Machiavelli (1970). For contemporary treatments of the theme see Pettit (1997) and Maynor (2003).
4. The Committee on Technological Literacy of the National Academy of Engineering—an association devoted to technological progress—has endorsed quite a robust conception of technological literacy. See Committee on Technological Literacy, National Academy of Engineering, National Research Council (2002). Perhaps the horizons of engineers are broader than those of physical scientists and mathematicians after all.